Optimal setting of bendable optics based on FEA calculations

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Abstract 250 words.

Recently, a technique for optimal tuning and calibration of bendable x-ray optics using surface slope data obtained with a slope measuring long trace profiler (LTP) was developed at the Advanced Light Source (ALS) optical metrology laboratory (OML) [Opt. Eng. 48(8), 083601 (2009)]. In this technique, slope distributions measured at different settings of the bending couples at each end of a flat substrate are used to construct bender characteristic functions. Using regression analysis with the experimental characteristic functions, optimal settings of the benders that best approximate the desired shape in slope are determined. In this work, we describe a method for finding a bender's characteristic functions based on Finite Element Analysis (FEA) of a complete mirror assembly. The accuracy of the characteristic functions found by simulation is verified by cross comparison with experimental characteristic functions for a long (450 mm) highly curved bendable mirror. The mirror has sagittally shaped substrate developed for the ALS MERLIN beamline 4.3.0, with a total slope variation 15 mrad. Calculating FEA characteristic functions in the design stage allowed better understanding of the design of the bender's adjustment mechanism. By calculating FEA characteristic functions a priori, we significantly decrease the time needed in the OML for tuning the mirror. Because the calculated characteristic functions are free of the errors inherent to measurements made in the lab, the tuning is even more accurate. Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

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